

AMENDMENTS TO THE CLAIMS

Please cancel claims 1-26. The pending claims will be as follows:

Claims 1-26 (cancelled)

Claim 27 (original): A water heater apparatus, comprising:

a burner;
a primary heat exchanger having an exterior surface exposed to the burner for receiving heat from the burner, and having an inner flow path for flowing water through the heat exchanger, the flow path having a water inlet and a water outlet;
a recirculation conduit communicating the water outlet with the water inlet and bypassing the heat exchanger;
a recirculation valve disposed in the recirculation conduit;
a water temperature sensor disposed in one of the inner flow path and the recirculation conduit; and
a controller, operably associated with the temperature sensor and the recirculation valve, for varying a position of the recirculation valve in response to the water temperature sensor.

Claim 28 (original): The apparatus of claim 27, wherein:

the water temperature sensor is located adjacent the water inlet to the inner flow path of the heat exchanger.

Claim 29 (original): The apparatus of claim 27, wherein:

the controller maintains the water temperature at the water inlet to the inner flow path of the heat exchanger at or above a selected temperature sufficient to prevent condensation of combustion products from the burner on the exterior surface of the heat exchanger.

Claim 30 (original): The apparatus of claim 29, wherein the selected temperature is at least 130°F.

Claim 31 (original): The apparatus of claim 27, further comprising:

a secondary heat exchanger located upstream of the primary heat exchanger so that incoming water flows first through the secondary heat exchanger and then through the primary heat exchanger; and

a combustion conduit for directing combustion products from the burner and the primary heat exchanger to the secondary heat exchanger, so that water flowing through the secondary heat exchanger is preheated by the combustion products before the water flows into the primary heat exchanger.

Claim 32 (original): The apparatus of claim 31, wherein:

the secondary heat exchanger is a condensing heat exchanger which allows condensation of the combustion products on the exterior of the secondary heat exchanger.

Claim 33 (original): The apparatus of claim 32, wherein:

a surface of the secondary heat exchanger exposed to combustion products is coated with a corrosion resistant coating to prevent corrosion resulting from the condensation.

Claim 34 (original): A method of heating water, comprising:

- (a) providing a burner having an operative range of energy output rates varying from an upper limit to a lower limit;
- (b) mixing combustion air and fuel gas to create an air and fuel mixture;
- (c) receiving the air and fuel mixture in an inlet of a variable output blower and delivering the air and fuel mixture from the blower to the burner;
- (d) heating a stream of water of a water heating system with heat input from a heat exchanger which receives heat from the burner;
- (e) monitoring a parameter of the water heating system; and
- (f) varying the output of blower in response to the monitored parameter and thereby varying the energy output rate of the burner and the heat input to the stream of water.

Claim 35 (original): The method of claim 34, further comprising:

upon start up of the burner, limiting the output of the blower to a selected fraction of a maximum output of the blower, so that the burner starts up at a selected reduced energy output rate less than its upper limit.

Claim 36 (original): The method of claim 35, further comprising:

after start up of the burner, operating the burner at a selected reduced energy output rate for an interval, then varying the blower output.

Claim 37 (original): The method of claim 34, further comprising:
controlling a fuel gas flow rate in response to the output rate of the blower, and thereby maintaining a constant air to fuel ratio received by the blower.

Claim 38 (original): The method of claim 34, further comprising:
maintaining a fuel gas flow rate proportional to a combustion air flow rate, and thereby controlling an air to fuel ratio of the mixture received by the blower.

Claim 39 (original): The method of claim 34, wherein:
in step (e) the monitored parameter is water temperature.

Claim 40 (original): The method of claim 34, wherein step (f) comprises:
varying a speed of an electric drive motor driving the blower.

Claim 41 (original): The method of claim 40, wherein:
the speed of the electric drive motor is varied by varying a frequency of an electric power signal provided to the electric drive motor.

Claim 42 (original): The method of claim 40, further comprising:
isolating the air and fuel mixture in the blower from the electric drive motor.

Claim 43 (original): The method of claim 34, further comprising:

preventing condensation of combustion products from the burner on the heat exchanger by recirculating water exiting the heat exchanger back to a water inlet of the heat exchanger until the temperature of water entering the heat exchanger exceeds a pre-determined minimum inlet temperature.

Claim 44 (original): The method of claim 34, further comprising:

pre-heating inlet water flowing to the heat exchanger by first flowing the inlet water through a secondary heat exchanger; and
after combustion products from the burner have passed the first heat exchanger, flowing those combustion products past the secondary heat exchanger to extract additional heat energy from the combustion products.

Claim 45 (original): A method of heating water, comprising:

- (a) providing a heat exchanger having a water flow path defined therethrough, the flow path having a water inlet and a water outlet;
- (b) heating the heat exchanger with a burner;
- (c) flowing water through the water flow path of the heat exchanger to heat the water;
- (d) monitoring temperature of the water;
- (e) when the monitored water temperature is below a lower limit temperature, recirculating at least a portion of the heated water exiting the water outlet back to the water inlet; and

(f) thereby maintaining water temperature within the heat exchanger above the lower limit temperature and preventing condensation of combustion products from the burner on an exterior of the heat exchanger.

Claim 46 (original): The method of claim 45, wherein step (e) comprises:

changing a position of a recirculation valve in response to the monitored water temperature.

Claim 47 (original): The method of claim 45, wherein step (d) comprises:

monitoring temperature of the water at the water inlet to the water flow path of the heat exchanger.

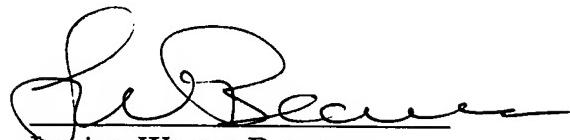
Claim 48 (original): The method of claim 45, wherein the lower limit temperature is at least 130°F.

Claim 49 (original): The method of claim 45, further comprising:

pre-heating inlet water flowing to the heat exchanger by first flowing the inlet water through a secondary heat exchanger; and

after combustion products from the burner have passed the first heat exchanger, flowing those combustion products past the secondary heat exchanger to extract additional heat energy from the combustion products.

Respectfully submitted,



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